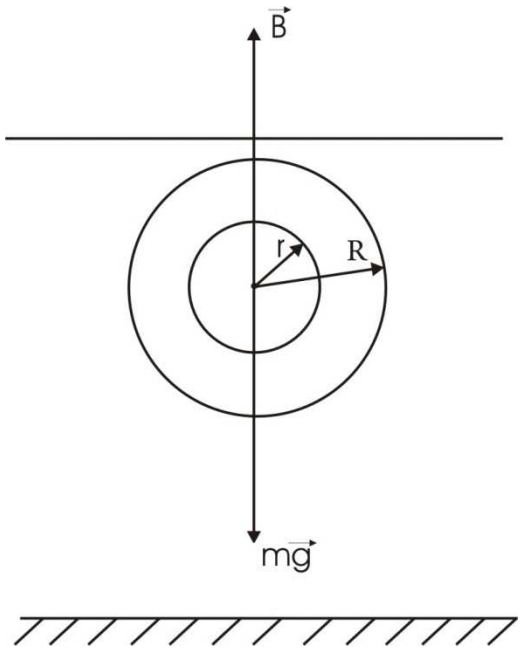
A concrete sphere of radius R, has a cavity of radius of r which is packed of saw dust. The specific gravity of concrete and saw dust are 2.4 and 0.3. The sphere floats with its entire volume submerged under water calculate the ratio mass of concrete and saw dust?

Solution.

$$R, r, \frac{\rho_1}{\rho_w} = 0.3, \frac{\rho_2}{\rho_w} = 2.4;$$

$$\frac{m_2}{m_1} - ?$$



ρ_w – the density of a water;

ρ_1 – the density of a saw dust;

ρ_2 – the density of a concrete;

The sphere floats with its entire volume submerged under water, this means the net force on the object is zero:

$$F_{net} = 0 = B - mg;$$

$$B = mg.$$

B – a buoyancy force.

A buoyancy force is:

$$B = \rho_w V g;$$

V - the volume of a concrete sphere.

$$m = m_1 + m_2;$$

m_1 - the mass of a saw dust;

m_2 - the mass of a concrete.

$$B = (m_1 + m_2)g;$$

$$\rho_w V g = (m_1 + m_2)g.$$

Divide by g:

$$\rho_w V = m_1 + m_2.$$

Divide by m_1:

$$\frac{\rho_w V}{m_1} = 1 + \frac{m_2}{m_1};$$

$$m_1 = \rho_1 V_1;$$

$$\frac{\rho_w V}{\rho_1 V_1} = 1 + \frac{m_2}{m_1};$$

V_1 - the volume of a cavity which is packed of saw dust.

$$V_1 = \frac{4}{3}\pi r^3;$$

$$V = \frac{4}{3}\pi R^3;$$

$$\frac{\frac{4}{3}\pi R^3 \rho_w}{\frac{4}{3}\pi r^3 \rho_1} = 1 + \frac{m_2}{m_1};$$

$$\frac{R^3 \rho_w}{r^3 \rho_1} = 1 + \frac{m_2}{m_1};$$

$$\frac{R^3}{r^3 \frac{\rho_1}{\rho_w}} = 1 + \frac{m_2}{m_1};$$

$$\frac{\rho_1}{\rho_w} = 0.3;$$

$$\frac{R^3}{0.3r^3} = 1 + \frac{m_2}{m_1};$$

$$\frac{m_2}{m_1} = \frac{R^3}{0.3r^3} - 1.$$

Answer: $\frac{m_2}{m_1} = \frac{R^3}{0.3r^3} - 1.$